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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This study investigates and analyzes the shipyard cost of naval combatants, i.e., the costs of those elements of the total ship system for which the shipbuilder is responsible, namely, the costs to the shipbuilder of the contruction and assembly of the platform. The analysis, confined to the cost of figate-sized follow ships, focused on wage scales for production-line and non-production line workers: overhead costs, including supplemental labor costs and fringe benefits; and costs of materials used by the shipyard. The study examines shipyard costs during the 1965/1969 period with costs currently experienced by the shipyard.

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Based on this analysis, the increased cost at the shipyard of frigate-sized naval combatants can be explained by the following factors: 1) the general inflationary trend within the U.S. economy; 2) increased overhead costs; 3) general increases in capital and energy costs; 4) underutilization of the full capacity of specific segments of the shipbuilding industry and 5) increased complexity of the modern naval combatant.

BUILDING NAVAL VESSELS:
A HANDBOOK OF SHIPYARD COSTS

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Prepared pursuant to Department of the Navy Contract No. N00014-79-C-0521.

March 1980

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I. EXECUTIVE SUMMARY

The purpose of this project was to provide the Naval Sea Systems Command with data, and an analysis of the data, that would allow it to more fully comprehend the reasons for the increased cost of naval combatants. The scope of the project, however, was to be limited by the following constraints:

- That the analysis be concerned solely with the shipyard cost of naval combatants, i.e. only with the costs of those elements of the total ship system for which the shipbuilder is responsible, namely the costs to the shipbuilder of the construction and assembly of the platform. The impact of costs of mission-related equipment on total ship systems costs was not analyzed.

- That the analysis be confined to the cost of follow ships and that no review be made of lead ship costs.

- That the analysis be confined to frigate-sized ships, specifically the FFG1, the 1052, and the FFG7 classes of ships.

- That the analysis be based, as much as possible, on shipyard and general industrial data as opposed to data provided by the Naval Sea Systems Command.

Based on our analysis, we now believe that the increased cost at the shipyard of frigate-sized naval combatants can be explained by the following factors:

- The general inflationary trend within our economy. Shipyard wage scales, for example, more than doubled between 1964/1965 and 1978/1979. During the same period of time, the cost of raw materials used in ship construction increased at an even faster pace. We now believe that these two factors account for the greater proportion of the increased shipyard cost of combatants.

- Increased overhead costs imposed on U.S. industry by private and government sponsored socio-economic programs such as Social Security, health and accident insurance programs, Workmen's Compensation programs, and general health and safety measures such as OSHA. In 1965, for example, fringe and related benefits were only a minor portion of total wage and salary payments. By 1979, these costs had increased in some cases to almost 50% of base wage and salary scales.

- Increased overhead costs imposed on the defense industry in general by the Department of Defense for enhanced quality control standards, integrated logistics support, and other similar programs designed to guarantee the quality, supportability, and maintainability of fighting equipment.

- Increased overhead costs imposed on industry by service-oriented state and local governments seeking to maximize tax revenues.

- The general increase in capital and energy costs which have "skyrocketed" since the early 1970s.

- The underutilization of the full capacity of specific segments of the shipbuilding and its related industries.

- Increased complexity of the modern naval combatant.

In general, we believe that the major portion of the increased shipyard cost of naval combatants can be explained by a conventional analysis of the costs of the factors of production used in the construction of a ship. It should be noted here, however, that no conclusions can be drawn from an analysis of this type on the efficiency of the shipbuilding industry. The notion of efficiency is beyond the scope of this specific project.

II. FOCUS OF THE STUDY

By direction, we were asked to compare the costs of the FFG1 class ships built at Bath Iron Works from 1963 through 1965 and the 1052 class ships built at Todd/Seattle from 1965 through 1969 with the FFG7 class ships now being built at these two yards. Because the FFG7 program is relatively new, we restricted our analysis to the FFG11 in construction at Bath Iron Works and the FFG22 in construction at Todd/Seattle. Data were not gathered on any of the other FFG7 class ships under construction at these two yards. Summary data on the shipyard cost of these vessels are shown in Table One.

The data show that the FFG1 and 1052 classes of ships are reasonably comparable with respect to shipyard costs if corrections are made for 1) the value of the propulsion plant provided to the shipyard on a GFE basis in the instance of the FFG1 class and 2) general, but small, increases during this period of time in the cost of shipbuilding material. The labor differential of $1,900,000 between the two classes of ships is consistent with known changes in wage scales in the industry between 1963/65 and 1965/69 plus wage scale differentials between the East and the West Coast. The $1,600,000 in differential overhead costs is similarly explainable. In other words, we do not see any major unexplainable discontinuity in cost between the FFG1 class ships built at Bath Iron Works and the 1052 class ships built at Todd/Seattle. A review of Naval Sea Systems Command data on total end costs confirms this contention.

At issue analytically, then, is the cost differential between the 1052 class ship and the FFG11 and FFG22 respectively. This matter is discussed in more detail in the sections that follow.

TABLE ONE
SHIPYARD COSTS FOR THE FFG1, THE 1052, AND FFG7 CLASS SHIPS

Year of Construction	1963/1965	1965/1969	1978/1980	1979/1981
Class or Ship	FFG1[1]	1052[2]	FFG11[3]	FFG18[4]
Costs: ($ in millions)				
Direct Labor	4.1	6.0	13.5	21.5
Direct Material	5.7[5]	11.7[6]	21.7	22.0
Overhead	3.0	4.6	12.9	21.5
	12.8	22.3	48.1	65.0
Estimated Profit	0.0	0.0	5.4	3.2
Total	12.8	22.3	53.5[7]	68.2[7]

Source: Corporate Data.

1 Average of the cost of FFG4, 5, and 6.
2 Average of the cost of the 1052, 1053, 1054, 1062, 1064, 1066, and 1070.
3 Unit cost of this ship only.
4 Unit cost of this ship only.
5 Propulsion plant not included.
6 Propulsion plant included.
7 "Real time" cost including escalation and change orders.

III. DIRECT LABOR

Based on the data made available to us the FFG1 class ships built at Bath Iron Works (1963-1965) required 1,400,000 hours of direct labor at an average cost of $2.92 per hour. Based on a 2080 man-hour year, this implies an average wage scale per production line worker of approximately $6100 per year.

For the 1052 class (1965-1970), Todd has similarily reported 1,400,000 direct man-hours of labor per ship which would suggest that these two classes of ships were equally "complex" from a shipbuilding perspective. Of the seven ships built, Todd reported average production line wages of $4.29 per hour or approximately $8,900 per year per production line worker.

For the FFG11, Bath Iron Works is now predicting 1,700,000 hours of direct labor to completion, at an average of $7.94 per hour, or $16,500 per year per production worker.

On the FFG22 Todd/Seattle's current estimate to completion is 1,900,000 hours of direct labor. This yields an average wage scale of $11.32 per hour, or approximately $23,500 per year per production worker. Table Two summarizes this information.

These data pose two analytical problems:

(1) Are the current wage scales at Bath Iron Works and Todd/Seattle consistent with industrial wage scales in general and with shipbuilding wage scales in particular?

(2) Why has the direct labor input to the FFG7 class ship increased to approximately 1,800,000 man hours from the 1,400,000 hours used to construct the FFG1 and 1052 class ships?

TABLE TWO
DIRECT LABOR HOURS AND DIRECT LABOR WAGES PER SHIP FOR THE FFG1 AND 1052 CLASS VESSELS AND THE FFG11 AND THE FFG18

Class or Ship	FFG1	1052	FFG11	FFG18
Production man hours	1,400,000	1,400,000	1,700,000	1,900,000
Average production wage/hour	$2.92	$4,29	$7.94	$11.32
Average production wage/year	$6,100	$8,900	$16,500	$23,500

Source: Corporate Data.

A. WAGE SCALES

In order to develop baselines for analyzing the economics of the shipbuilding industry we collected Census of Manufactures data for the industry for the period 1961 through 1976. This data, arrayed in Exhibit I, was used to derive production line wage scales for the industry as shown in Table Three.

Based on a review of these data, it is reasonably evident that the wage scales paid by Bath for the FFG1 class ships were consistent with those found in the industry in the 1963 through 1965 time frame. As an East Coast yard, Bath would normally expect its wage scales to be somewhat below the industry average, for reasons described below.

Similarly, the wage scales paid by Todd/Seattle during the period in which it was constructing the 1052 class ship appear to be consistent with industry behavior during the 1965 through 1969 time frame. The five year average for the industry was then $3.49 per hour. An $.80 per hour or a 23% differential between average wage scales in the industry and those recorded by Todd/Seattle is reasonably consistent with its West Coast location and the fact that, unlike Bath, it must compete with other large firms, e.g., Boeing and Lockheed, for labor.

The more critical questions then are whether:

(1) The trend in shipbuilding industry wage scales is consistent with the trend in wage scales in the general economy.

(2) The current wage scales (1979) paid by Bath and Todd are consistent with known trends in our economy and with the trend in general shipbuilding industry wage scales.

SIC 3731: SHIPBUILDING AND REPAIRING - EXHIBIT I

Year	# of Companies	Production Workers Number (000)	Production Workers Payroll (000,000)	Non-Production Workers Number (000)	Non-Production Workers Payroll (000,000)	All Employees Number (000)	All Employees Payroll (000,000)	Total Payroll Per Total Employees (000)	Capital Expenditure (000,000)
1961	NA	96	569	18	160	114	729	6.4	32
1962	NA	94	577	18	156	112	733	6.5	23
1963	305	97	610	18	172	115	782	6.8	25
1964	NA	97	633	18	187	115	820	7.1	33
1965	NA	110	738	20	208	130	946	7.3	45
1966	NA	114	819	21	239	135	1058	7.8	53
1967	389	114	819	25	257	139	1076	7.7	70
1968	NA	118	867	24	266	142	1133	8.0	76
1969	NA	118	928	25	284	143	1212	8.5	88
1970	NA	106	870	24	291	130	1161	8.9	145
1971	NA	105	879	23	301	128	1180	9.2	89
1972	415	118	1053	27	369	145	1422	9.8	142
1973	NA	121	1134	31	426	152	1560	10.3	131
1974	NA	129	1291	33	478	162	1769	10.9	216
1975	NA	133	1461	34	535	167	1996	12.0	298
1976	NA	132	1619	34	600	166	2219	13.4	355

(continued on next page)

SIC 3731: SHIPBUILDING AND REPAIRING - EXHIBIT I (cont.)

Capital Expenditure Per Total Employees (000)	Gross Fixed Assets (000,000)	Assets Per Total Employee (000)	Cost of Materials (000,000)	Cost of Materials Per Total Employees (000)	Value of Shipments (000,000)	Capital Expenditure Per Value of Shipments
.3	--	--	701	6.1	1621	50.7
.2	482	4.3	716	6.4	1670	72.6
.2	506	4.4	670	5.8	1680	67.2
.3	539	4.7	768	6.7	1826	55.3
.3	--	--	870	6.7	2078	46.2
.4	--	--	984	7.3	2339	44.1
.5	690	5.0	1088	7.8	2518	36.0
.5	729	5.1	1142	8.0	2488	32.7
.6	827	5.8	1108	7.7	2560	29.1
1.1	832	6.4	1075	8.3	2682	18.5
.7	1022	8.0	1186	9.3	2761	31.0
1.0	1227	8.5	1400	9.7	3281	23.1
.9	1297	8.5	1743	11.5	3959	30.2
1.3	1531	9.5	2264	14.0	4825	22.3
1.8	1809	10.8	2692	16.1	5615	18.8
2.1	2157	13.0	2610	15.7	5896	16.6

TABLE THREE
AVERAGE PRODUCTION LINE WAGES
U.S. SHIPBUILDING INDUSTRY (SIC 3731)
1961-1976

Year	Average Production Wages/Year ($)	Average Production Wages/Hour[1] ($)
1961	5,927	2.85
1962	6,138	2.95
1963	6,289	3.02
1964	6,526	3.14
1965	6,709	3.23
1966	7,184	3.45
1967	7,184	3.45
1968	7,347	3.53
1969	7,864	3.78
1970	8,208	3.95
1971	8,371	4.02
1972	8,924	4.29
1973	9,372	4.50
1974	10,008	4.81
1975	10,985	5.28
1976	12,265	5.89

Source: U.S. Department of Commerce, Census of Manufactures; Exhibit I.

[1] 2080 man-hours = 1 man year.

Question One is easily answered. Table Four presents data on production line wage scales for five heavy industries. To the extent that these industries are representative of the trend in production wage scales in U.S. heavy industry, as we believe they are, it can be concluded that the trend in shipbuilding wage scales is consistent with that found in U.S. heavy industry in general.

The remaining question, then, is whether the current production line wage scales for Bath and Todd/Seattle are consistent with known inflationary trends within our economy since 1976. Table Five presents data on this. When corrections for labor mix (to be discussed later) are made, Bath's 1979 wage scale of $7.94 per hour is consistent with an 8% per year escalation rate.

The current wage rates at Todd/Seattle, however, are not as easily explained. Current wage scales, corrected for labor mix, are $11.10 per hour. This would suggest a $3.50 per hour regional premium from the East Coast to the West Coast. This is more than might otherwise be expected from an analysis of available data. Exhibit II presents wage scale data for the industry for 1976 and shows average wage scales on the West Coast of $7.50 per hour in 1976. An 8% escalation rate would have brought this to only $9.45 in 1979, still leaving $1.65 per hour unexplained.

The explanation, however, is found in an analysis of regional differences within the West Coast itself. Shipyards in the Pacific Northwest are subject to a regional labor contract which includes thirteen shipyards, ten of which are repair yards only and three of which (Todd/Seattle, Lockheed, Tacoma) are either ship or boat builders. Management at Todd/Seattle maintains that the dominance in the area of repair yards has helped create an economic climate in which price is secondary to "turn around time" for vessels in for repairs such

TABLE FOUR
AVERAGE PRODUCTION LINE WAGES, PER YEAR
SELECTED INDUSTRIES
1961-1976

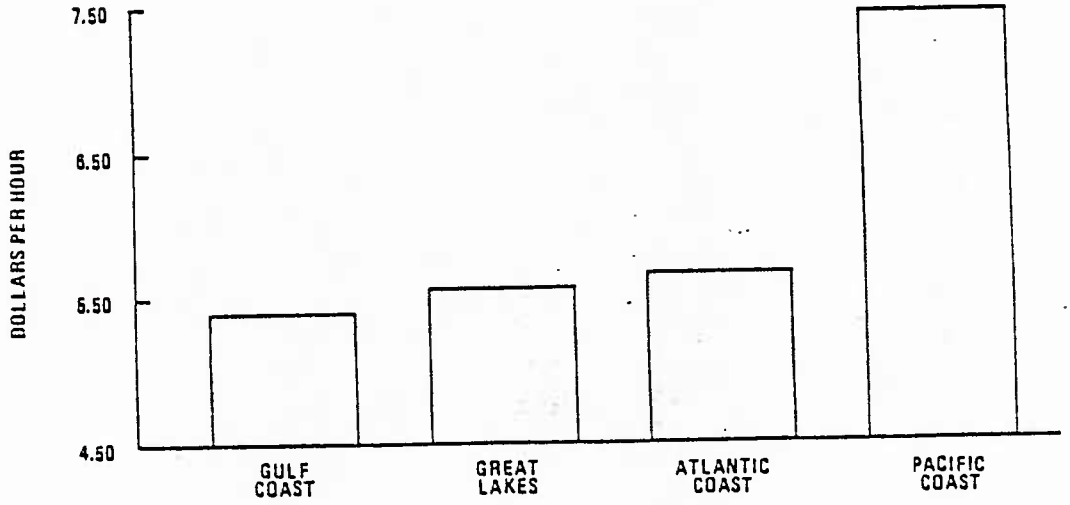
Year	Shipbuilding SIC 3731	Aircraft SIC 3721	Iron & Steel Forgings SIC 2462	Int. Combustion Engines SIC 3519	Pumps & Pumping Eqpt. SIC 3561
1961	$5,927	$5,917	$6,129	$5,411	$5,297
1962	6,138	6,283	6,485	5,634	5,631
1963	6,289	6,589	6,828	6,190	5,769
1964	6,586	7,631	7,133	6,380	6,116
1965	6,709	6,797	7,563	6,488	6,340
1966	7,184	7,311	8,152	7,277	6,608
1967	7,184	7,823	8,060	7,187	6,700
1968	7,347	7,829	8,437	7,460	6,938
1969	7,864	8,300	8,788	8,370	7,440
1970	8,208	9,359	9,138	8,627	7,764
1971	8,371	9,578	9,407	9,000	8,065
1972	8,921	10,170	10,889	10,288	9,408
1973	9,372	10,524	11,581	11,280	9,026
1974	10,008	11,280	12,281	12,311	9,854
1975	10,985	12,787	12,500	12,589	10,900
1976	12,265	14,712	13,367	14,137	11,846
PERCENT CHANGE:					
1961-1976	107	149	118	161	105

Source: U.S. Department of Commerce, Census of Manufactures.

TABLE FIVE
HOURLY WAGE RATES: 1977-1979
BASED ON 1976 HOURLY WAGE RATES AND VARYING RATES OF ESCALATION, 1977-1979
($)

Year	Escalation Rates			
	6%	8%	10%	12%
1976	5.89	5.89	5.89	5.89
1977	6.24	6.36	6.48	6.60
1978	6.61	6.87	7.13	7.39
1979	7.01	7.42	7.84	8.28

EXHIBIT II



SOURCE: BLS (12/77)

REGIONAL MEDIAN HOURLY EARNINGS BY SHIPYARD WORKERS (SEPTEMBER 1976)

Source: Annual Report of the Status of the Shipbuilding and Ship Repair Industry of the United States, 1977, Department of Defense

that the unions representing production line workers are able to bargain for wages substantially higher than would otherwise obtain were the shipbuilding job opportunities in the area limited, as they are in most key geographical areas, to only one or two shipbuilders. In economic terms, this outcome is consistent with generally accepted labor relations theory and practice. Insofar as the Navy needs to maintain a shipbuilding and repair capability in the Pacific Northwest, it has no choice but to pay the wage scale premium called for in the region. Regional differences in wage scales are a fact of life.

Based on the wage scale data, then, we believe that it is reasonably safe to conclude that the direct labor costs required to construct the FFG11 and FFG22 are not inconsistent with general economic trends within the United States. This statement neither condemns nor justifies the cost but simply states, subject to the change in man-hours of direct labor, that there is no unexplainable discontinuity in the labor portion of the total shipyard cost of constructing an FFG1, 1052, or an FFG7 class follow ship. The as yet unexplained variation in direct labor hours per ship is discussed in the section that follows.

B. CHANGES IN DIRECT LABOR MAN-HOURS

In keeping with Cost Accounting Standards Board rules and regulations, Bath Iron Works and Todd, prior to the receipt of the various contracts for the FFG7 class vessels, reclassified as direct labor certain shipbuilding costs heretofore classified as overhead, e.g., purchasing, quality assurance, certain data processing functions, etc. The management of each of the shipyards visited during the field phase of this projct stated that this requirement accounted for the 300,000 man-hour direct labor differential noted earlier between the FFG1 and 1052 class ship, and the FFG7 class vessel and that, from their point of view as shipbuilder, the three classes of ships reviewed in this project were of equal complexity. In other words, the management of both shipyards believe, and offered reasonable proof, that the FFG7 class of ships required no more direct hours of construction line labor than did either the FFG1 or 1052 classes.

It should be noted here, when spread over three years, that 50 persons account for 300,000 man-hours of labor. In this regard, Todd management specifically noted that they now have a 40 man quality assurance program office for the FFG7 class ship, a function that was performed solely by the Navy on the 1052 class vessel. They also stated that the Todd Program Office for the 1052 program was staffed by 2 persons whereas the Todd Program Office is now staffed by 10 personnel. Bath cited a 14 person Data Processing unit, a 5 person Industrial Relations group, and a 3 person Overhead Budgeting Group as instances of costs reclassified, for contractural purposes, from overhead and into the direct labor category. In addition, both stated that the FFG7 program contract required them to perform functions, e.g., integrated logistics support, that they were not required to perform on either their FFG1 or 1052 contracts. This, then, leads to the conclusion that the 1,400,000 in direct man-hours used to construct the FFG1 and 1052 class ship is comparable to the 1,700,000 man-hours allocated as direct labor on the FFG7 class. This, of

course, is subject to the caveat that the size of the overhead labor force is smaller than might otherwise be anticipated based on current standards within the industry. As will be discussed in the Overhead Section of this report, this appears to be so, i.e., the indirect labor portion of overhead costs are somewhat lower in each of the two yards than might otherwise be anticipated.

This, of course, leaves unexplained the 200,000 man-hour increment between predicted man-hours to complete the FFG11 at Bath and to complete the FFG22 at Todd/Seattle. Todd management stated that they were as yet not able to fully explain this difference. They currently attribute the labor hour overrun to two specific areas: the electric/electronics area, and their different relationship to the design agent (Gibbs & Cox). On the 1052 class they noted that they had "control" of the design such that they could reject any change suggested by the agent. They do not now have this option available to them except as they take responsibility for refusing to act on a change specified by the design agent. They believe that a portion of the 200,000 in unaccounted for direct labor is due to problems created by this relationship.

Apart from the 200,000 man-hour differential at Todd/Seattle, then, the increased indirect labor costs between the FFG1, 1052, and FFG7 classes of ships can be explained by a reasonably standard financial and economic analysis. Although the costs appear to be radically higher from one class of ship to another, nearly all of these differences are due to (1) wage scale inflation in the general economy and (2) regional differences in wage scales in the shipbuilding industry.

Once again, it should be noted here that an analysis of this type can make no valid statements on the efficiency of the two contractors involved. All that can be said is that Bath appears to be constructing the FFG7 class ships for which it is responsible as efficiently as it constructed the three

FFG1 class vessels if the ships are, in fact, of equal complexity from a ship construction perspective. Conversely, if the 1052 class is directly comparable to the FFG7 class ship, then Todd/Seattle appears to be somewhat less efficient than might otherwise be anticipated. In absolute terms, Todd/Seattle is somewhat less efficient than Bath but it would be specious analytically to assume that the two yards are able to be directly compared in this regard.

IV. OVERHEAD RATES AND COSTS

In order to begin our analysis of the overhead rates and costs incurred in the three programs under review, we once again began with a review of the data set out in Exhibit I. Given the limitations of this data, we defined:

1. Overhead as the arithmetic equivalent of sales less the sum of direct labor and direct material costs. Overhead Costs = Sales - (Direct Labor Costs + Direct Material Costs).

2. The overhead rate as the equivalent of overhead costs divided by direct labor costs. Overhead Rate = $\frac{\text{Overhead Costs}}{\text{Direct Labor Costs}}$.

We are aware that defining overhead as we have done is somewhat of a simplification inasmuch as it includes 1) some costs that industry normally categorizes as direct and 2) earned profits. Conversely, this definition of overhead and of overhead rates is reasonably consistent with government procedures and sufficient for our purposes to allow us to discern and interpret trends.

Table Six presents data on the outcome of this analysis and shows the trend in overhead costs and rates for the industry for the fifteen years for which complete data is available. Other than for 1968 and 1969, the trend has been steadily upwards with a sharp acceleration seen after 1973 due, no doubt, to the rapid runup in energy and other costs during the 1973/74 time frame.

In order to determine whether the trend we observed in the shipbuilding industry was consistent with trends in the U.S. economy as a whole we once again derived data for four other industries. These data are set out in Table

TABLE SIX
OVERHEAD RATES
1961-1976
SIC CODE 3731

YEAR	OVERHEAD ($000,000)	DIR. LABOR ($000,000)	OVERHEAD RATE 1÷2
1961	351	569	61.7%
1962	377	577	65.3
1963	400	610	65.6
1964	425	633	67.1
1965	470	738	63.7
1966	536	819	65.4
1967	611	819	74.6
1968	479	867	55.2
1969	524	928	56.5
1970	737	870	84.7
1971	696	879	79.2
1972	828	1053	78.6
1973	1082	1134	95.4
1974	1270	1291	98.4
1975	1462	1461	100.1
1976	1667	1619	103.1
	(1)	(2)	(3)

N.B.: OVERHEAD (COLUMN 1) = SALES - (DIRECT LABOR COSTS + DIRECT MATERIAL COSTS)

SOURCE: CENSUS OF MANUFACTURES (COLUMNS 1, 2); EXHIBIT 1.

Seven. As shown, there has been a steady increase in overhead costs and overhead rates throughout U.S. industry for the period under review. The observed behavior of the U.S. shipbuilding industry is consistent with that found in the U.S. economy as a whole, although a case can be made for alleging that the rate of growth in overhead costs in shipbuilding has lagged behind that in the economy in general.

Here it should be noted that this is neither "good" nor "bad"; it simply is.

TABLE SEVEN
OVERHEAD RATES
SELECTED INDUSTRIES
1961-1976
(%)

Year	Shipbuilding SIC 3731	Aircraft SIC 3721	Iron & Steel Forgings SIC 3462	Int. Combust. Engines SIC 3519	Pumps & Pumping Eqpt. SIC 3561
1961	61.7	197.6	96.8	181	237
1962	65.3	197.4	107.9	163	224
1963	65.6	223.0	101.0	205	237
1964	67.1	183.2	129.0	195	235
1965	63.7	219.2	107.0	201	234
1966	65.4	264.8	117.8	190	239
1967	74.6	201.4	127.4	190	251
1968	55.2	240.2	127.0	186	263
1969	56.5	261.2	125.5	179	255
1970	84.7	262.5	112.1	201	254
1971	79.2	302.9	116.1	225	267
1972	78.6	257.1	127.2	193	224
1973	95.4	310.8	123.1	190	396
1974	98.4	313.3	144.3	175	400
1975	100.1	336.0	175.5	208	451
1976	103.1	348.1	180.3	211	490
PERCENT CHANGE:					
1961-1976	67	76	86	17	107

Source: Based on Census of Manufactures Data.

A. OVERHEAD COSTS

In order to determine whether the trends in overhead costs and rates between the FFG1, 1052, and FFG7 programs were consistent with trends within the general shipbuilding industry and, in turn, consistent with trends within the economy as a whole, we recast the data on the FFG7 program by reclassifying into overhead the 300,000 man-hours of labor now reported in the direct labor category. Tables Eight and Nine show the impact on the various cost categories resulting from this labor classification change.

These tables present us with a number of analytical issues:

- Bath's overhead rate on the FFG1 program was some 30% higher than would be anticipated by a review of data on the industry.

- Todd's overhead rate on the 1052 was consistent with average rates within the industry during the 1965 through 1970 time frame when corrections are made for the statistical aberrations in 1968 and 1969.

- The corrected overhead rate on the FFG7 program appears to be considerably higher than might otherwise be anticipated from a simple extrapolation of data on the industry (Table Six). Based on industry data, and known trends within our economy, we would anticipate a current average overhead rate in the industry of 113% of direct labor. This would suggest that the overhead rates on the FFG7 programs are some 20 to 24% higher than might othewise be anticipated from a review of trends within the shipbuilding industry in particular and the economy in general.

- If we accept this 24% figure as correct, the cost of the FFG11 now being built at Bath Iron Works is some $2,800,000 higher than would otherwise be anticipated. The equivalent figure for Todd/Seattle is some $4,500,000.

TABLE EIGHT
OVERHEAD COSTS AND RATES
FFG1, FFG7 PROGRAMS
BATH IRON WORKS

	FFG1	FFG7 Original	FFG7 Revised
Direct Labor	$ 4,100,000	$13,500,000	$11,100,000
Overhead	3,000,000	12,900,000	15,300,000
Total	$ 7,100,000	$26,400,000	$26,400,000
Hours of Direct Labor	1,400,000	1,700,000	1,400,000
Hourly Wage Rate-Production Workers	$2.92	$7.94	$7.94
Overhead Rate	73.2%	95.5%	137.8%

TABLE NINE
OVERHEAD COSTS AND RATES
THE 1052, FFG7 PROGRAMS
TODD/SEATTLE

	1052	FFG7 Original	FFG7 Revised
Direct Labor	$ 6,000,000	$21,500,000	$18,100,000
Overhead	4,600,000	21,500,000	24,900,000
Total	$10,600,000	$43,000,000	$43,000,000
Hours of Direct Labor	1,400,000	1,900,000	1,600,000
Hourly Wage Rate- Production Workers	$4.29	$11.32	$11.32
Overhead Rate	76.6%	100.0%	137.6%

At the present time, we have no full explanation for this apparent discontinuity. Here it should be noted that the effect of this discontinuity, if it cannot otherwise be explained, serves to increase above predictable trend the cost of the FFG22 (Todd) by 6.5% and that of the FFG11 (Bath) by 5.2%. Here we would caution against imputing any great degree of significance to these figures in that:

- First and foremost, the FFG7 program is not yet far enough along to draw definitive conclusions on costs and the trends in these costs. Further, a 5% or 6% variation from apparent cost trends within the industry is no doubt consistent with the increased complexity of a naval combatant vis a vis noncombatant or commercial vessel.

- Based on the FFG1 program, Bath appears historically to have had an overhead rate higher than the industry as a whole. As such the higher overhead rate at Bath might well have been anticipated.

- Last, and perhaps most important of all, the use of a "rate" is an analytical technique only. The more important figure is the actual cost itself...the $12,900,000 (or $15,300,000) per ship at Bath and the $21,500,000 (or $24,900,000) at Todd/Seattle actually being spent to construct the FFG7 class. A very substantial portion of these costs can be explained, as will be discussed below, by a review of labor and labor related costs at each of these yards.

B. SUPPLEMENTAL LABOR COSTS

One of the major factors underlying the rapid increase in overhead costs in the U.S. economy is a somewhat hidden growth in the cost of labor. Table Three shows, for example, that average production line wages in the shipbuilding industry increased from approximately $7,180 in 1966 to $12,265 in 1976. Further increases have, of course, been recorded through 1979 such that an average wage scale of some $17,000 per year per person should now be anticipated.

However, concentrating on wage scales alone hides the more rapid growth in non-wage benefits which have served to increase radically the overall cost of labor throughout U.S. industry. Tables Ten and Eleven present data on some of the so-called supplemental labor costs that must now be absorbed by the U.S. shipbuilding industry, e.g., Social Security payments, health and accident insurance policies, and other cash payments made by the employer for the benefit of the shipyard employee. These Tables point to key reasons for the rapid runup in overhead costs between the FFG1, 1052, and FFG7 programs:

- As shown in Table Ten, "Supplementary Labor Costs" in the industry increased from $120,000,000 in 1967 to $417,000,000 in 1976 or from $935 per year per employee in 1967 to $2512 per year per employee in 1976. On the reasonably correct assumption that a frigate-sized combatant requires 1200 man-years of labor for completion, the overhead costs incurred in the construction of such a ship would have increased by $1,902,400 for this one item alone from 1967 through 1976, or from $1,112,000 per ship in 1972 to $3,014,000 per ship.

- If direct comparisons between the FFG1 and FFG7 class ships are desired, Table Eleven is even more revealing. For ships in the FFG1 and FFG7 classes, which required some 1000 man-years of direct labor, and 200 man-years of overhead labor, the cost to the shipyard of

TABLE TEN
SUPPLEMENTAL LABOR COSTS
1967 - 1976
SIC CODE 3731

YEAR	NUMBER OF EMPLOYEES (000)	SUPPLEMENTAL LABOR COSTS ($000,000)	SUPPLEMENTAL COSTS PER EMPLOYEE ($) 2÷1
1967	139	120	935
1968	142	137	965
1969	143	144	1007
1970	130	153	1177
1971	128	163	1273
1972	145	195	1345
1973	152	252	1651
1974	162	293	1809
1975	167	302	1808
1976	166	417	2512
	(1)	(2)	(3)

N.B.: Number of employees includes both production line and non-production line employees.

Source: U.S. Department of Commerce, Annual Survey of Manufactures 1976.

TABLE ELEVEN

Social Security Taxes

Year	Yearly Wage Subject to Tax	Maximum Tax (both employer and employee must pay this amount)
1960-61	$4,800	$144.00
1962	$4,800	$150.00
1963-65	$4,800	$174.00
1966	$6,600	$277.20
1967	$6,600	$290.40
1968	$7,800	$343.20
1969-70	$7,800	$374.40
1971	$7,800	$405.60
1972	$9,000	$468.00
1973	$10,800	$631.80
1974	$13,200	$722.20
1975	$14,100	$824.85
1976	$15,300	$895.05
1977	$16,500	$965.25
1978	$17,700	$1,070.85
1979	$22,900	$1,403.77
1980	$25,900	$1,587.67
1981	$29,700	$1,975.05
1982	$31,800*	$2,130.60
1983	$33,900*	$2,271.30
1984	$36,000*	$2,412.00
1985	$38,100*	$2,686.05
1986	$40,200*	$2,874.30
1987	$42,600*	$3.045.90

*Estimated by Social Security Administration under an automatic escalator provision linking the wage base to the rise in average wages.

Source: Research Institute Recommendations, Research Institute of America, Mt. Kisco, N.Y., December 14, 1979, p. 4.

Social Security taxes alone for the 1200 man-years needed to construct this ship would have increased from $208,800/ship in 1962 to $1,684,524/ship in 1979. Put another way, the Social Security tax costs on the FFG1 class vessel would have accounted for $200,000 of the $3,000,000 in overhead costs needed to construct this class vessel, or 6.66% of all overhead costs. On the FFG7, the $1,684,524 in Social Security taxes built into the cost of the ship would have absorbed some 13.2% of the overhead costs incurred at Bath Iron Works. Here it should be noted that these costs are not under the control of management but are in fact federally mandated cost increases.

Social Security taxes, however, are but one form of supplemental labor cost. There are, in fact, a broad range of other such costs now being absorbed by U.S. industry and, for contract or accounting purposes, classified as overhead. Although not specifically applicable to the shipbuilding industry, Table Twelve provides data on the more general trend within our economy. In 1967, for example, benefit payments were 23.5% of wage payments. By 1977, the last year for which data is available, they had increased to 31.5%.

If, once again, we assume the construction of a ship requiring 1200 man-years of labor both in 1967 and 1976, and apply the 23.5% and 31.5% baseline noted in Table Twelve to average industry wage scales of $7,700 in 1967 and $13,400 in 1976, we would find that these costs accounted for $2,171,400 of the costs charged to overhead in 1967, and $5,065,200 of the costs charged to overhead in 1976. Whereas wages defined as such would have increased by 74% during the ten year time span, overhead costs related to these wage payments increased by 133%. These increased payments to labor are one of the major factors driving overhead rates within the U.S. economy and, in fact, account for a heavy portion of the increase in overhead costs and rates between the FFG1, 1052, and FFG7 classes of combatants. Indeed, a full investigation of these costs reveals that they are the major cost absorbed in overhead at Todd/Seattle.

TABLE TWELVE
GROWTH OF EMPLOYEE BENEFITS
1929 - 1977

TYPE OF PAYMENT	1929	1957	1967	1977
	(PERCENT OF WAGES AND SALARIES)			
1. Legally required	0.8%	3.7%	6.3%	9.0%
Old-Age, Survivors, Disability and Health Insurance	0	1.5	3.2	4.5
Unemployment Compensation	0	0.8	0.8	1.2
Workmen's Compensation	0.6	0.5	1.0	1.0
Government employee retirement	0.2	0.7	1.0	2.0
Other	0	0.2	0.3	0.3
2. Agreed-upon	0.4	3.9	5.0	8.1
Pensions	0.2	2.4	2.6	3.7
Insurance	0.1	1.2	2.1	4.0
Other	0.1	0.3	0.3	0.4
3. Rest periods	1.0	3.0	3.3	3.8
4. Time not worked	0.7	6.4	7.6	9.5
Vacations	0.3	3.3	3.9	4.9
Holidays	0.3	2.2	2.6	3.2
Sick leave	0.1	0.8	0.9	1.2
Other	0	0.1	0.2	0.2
5. Bonuses, profit-sharing, etc.	0.1	1.0	1.3	1.1
Total benefit payments	3.0%	18.0%	23.5%	31.5%
		(Billion dollars)		
Wages and salaries	$50.4	$239.3	$427.5	$983.6
Total benefit payments	$ 1.5	$ 43.0	$100.0	$310.0

Source: Estimated by Chamber of Commerce of the United States.

Table taken from Employee Benefits 1978, the Chamber of Commerce of the United States

C. FRINGE BENEFITS AND RELATED COSTS: TODD/SEATTLE

Supplemental wage costs at Todd/Seattle have increased even more than noted above reflecting two factors:

- The wage scales in the Pacific Coast Conference to which Todd as a union shop belongs.

- The extremely high cost of Workmen's Compensation Insurance required at facilities covered by the Harbor and Longshoreman's Act. In 1979, Workmen's Compensation by itself represented a charge to overhead equal to 15% of all direct labor charges.

Data on actual wage costs at the yard for January 1975 and July 1979 are presented below:

	Jan. 1975	July 1979
Direct Wage	$6.48	$11.10
Related Fringe and Supplemental Labor Costs	2.40	5.33
Total hourly labor cost	$8.88	$16.43
Fringe as a % of direct labor hourly rate	37%	48%

If the current $5.33 per hour rate is applied to the actual overhead costs incurred by Todd shipyards in the construction of the FFG22, this would then mean that approximately $10,000,000, or 47% of the cost now being charged to the overhead cost account is, in fact, labor-related. Bath indicated that its current rate for the equivalent supplemental labor costs was approximately 40%

of direct labor or $3.18 per hour. For Bath, that means that approximately $5,400,000 of the total overhead cost charged to the FFG11 is due to supplemental labor costs, most of which are legislatively mandated. These costs account then for almost 42% of the total overhead costs charged to the FFG11. Many of these costs were either non-existent or virtually negligible in 1963/65 when the FFG1 class was built, and significantly greater today than when the 1052 class was constructed at Todd/Seattle in 1965/1970.

Although it is beyond the scope of this paper, it is reasonably evident that there have been major structual changes in the economy since the mid-1960s and that these have served to increase the actual cost of labor at a far faster rate than is generally realized. Because of accounting conventions, these labor-related costs are generally included in the overhead accounts despite the fact that this convention obscures the full cost of production line labor. Correcting for this convention, however, will not serve to reduce total cost but only to shift it from one account to another, i.e., from overhead to direct labor.

More important to our analysis, however, is the fact that this trend has occured throughout our entire economy and helps to explain the trend in overhead rates shown in Tables Six and Seven. In other words, we now see little discontinuity between trends in overhead costs and rates for the economy as a whole and the trends exhibited in the FFG1, 1052 and FFG7 programs.

D. INDIRECT LABOR

In order to verify the contention that the direct labor charge on the FFG7 program included the personnel normally charged as overhead, we asked for data on the number of personnel charged to various overhead accounts at both yards. Bath reported that 600 people, or 13.0% of its 4600 personnel were now carried as "indirect labor". The equivalent figure for Todd/Seattle was 15.2% or 550 persons out of a total labor force of 3600. Both of these figures are significantly lower than what would otherwise be expected from a review of data in the industry (Table Thirteen), and would appear to support their contentions that changes in manpower reporting techniques account for the 300,000 direct man-hour differential between the FFG1 and 1052, and the FFG7 class ships.

TABLE THIRTEEN
NON-PRODUCTION LABOR FORCE AS A PERCENT OF TOTAL LABOR FORCE
1961 - 1976
SIC CODE 3731

YEAR	TOTAL (000)	NON-PROD. (000)	NONPROD. ÷ TOTAL 2÷1
1961	114	18	15.8%
1962	112	18	16.1
1963	115	18	15.7
1964	115	18	15.7
1965	130	20	15.4
1966	135	21	15.6
1967	139	25	18.0
1968	142	24	16.9
1969	143	25	17.5
1970	130	24	18.5
1971	128	23	18.0
1972	145	27	18.6
1973	152	31	20.4
1974	162	33	20.4
1975	167	34	20.4
1976	166	34	20.5
	(1)	(2)	(3)

Source: Census of Manufactures (Columns 1, 2); Exhibit 1.

E. SUMMARY

Based on our review of the data made available to us, and a comparison of these data with trends in the economy as a whole, we do not now see any major discontinuity in either the direct labor or overhead accounts at the shipyard level between the FFG1, 1052 and FFG7 programs. The most cogent reality underlying these figures is (1) the high rate of inflation that has obtained in the economy since the early 1970s, and (2) the significant change in the structure of wage and salary payments in the United States since 1965.

The difference in the cost between the FFG11 (Bath) and the FFG22 (Todd) is, for the most part, a function of regional differences in wage scales once corrections have been made for the 200,000 hours of additional labor now required by Todd on its FFG7 class vessels.

V. DIRECT MATERIAL

Of the three major cost categories - Direct Labor, Overhead, and Direct Material - we believe that the trend in the cost of Direct Material is perhaps the least complex to identify and analyze.

In order to accomplish this task, we relied on three specific data bases:

- Once again, we used Exhibit I as a major source document, this time to determine the trend in the dollar value of the materials used by shipyard workers.

- Comparative data on material utilization rates per production line worker in four other industries; i.e., the aircraft, iron and steel forgings, internal combustion engine and pumps and pumping equipment industries.

- Specific data on the prices of a limited number of raw materials and metals commonly used in the shipbuilding industry. These data are direct indicators of the material cost inflation to which the industry has been exposed since 1961.

A. RAW MATERIAL PRICES

Before discussing the data set out in Tables Fourteen and Fifteen, it should be noted here that we are aware of the fact that the range of raw materials used in the FFG7 class is not a duplicate of the material used in the FFG1 or 1052 class. We are aware, for example, of (1) the change in propulsion system in the FFG7 from the two earlier classes of vessels and the implication of this change on the type of materials and other equipment going into the FFG7 class ship; and (2) the greater use of electronics and other equipment for ship control purposes in the FFG7 class vis a vis the FFG1 and 1052 classes. Notwithstanding these changes, we believe that the use of general economic data is sufficiently revealing for the purposes of this project since a review of the data on the shipbuilding industry strongly suggests that the rate of utilization of raw material has not changed in the industry, i.e., that there has been a relatively constant substitution factor.

In order to develop comparative data, we have reduced the material cost for the 1052 by some $5,000,000 to account for the fact that its propulsion system was supplied by the contractor, whereas it is GFE on FFG1 and FFG7 class ships. This adjustment then gives us the following revised material costs for the three ships.

FFG1 - $ 5,700,000 (1963/1965)
1052 - $ 6,700,000 (1965/1970)
FFG7 - $21,700,000 (1978/1980)

Based on this, the direct material cost for these three classes of combatants increased by a very moderate 17.5% from 1963/1965 to 1965/1970 (FFG1 vs 1052) and by an apparently extreme 224% from 1965/1970 (1052 vs FFG7) and 281% from 1963/1965 respectively to 1978/1980 (FFG1 vs FFG7).

TABLE FOURTEEN
PRICES OF RAW MATERIALS USED IN THE SHIPBUILDING INDUSTRY
1965 - 1978

Year	c/lb.					Indexed (1967=100)				
	Steel Plates	Structural Shapes	Hot-Rolled Strip	Hot-Rolled Sheet	Merchant Bars	Steel Plates	Structural Shapes	Hot-Rolled Strip	Hot-Rolled Sheet	Merchant Bars
1965	5.55	5.70	5.30	5.30	5.925	98.8	97.4	97.2	97.2	100.0
1966	5.55	5.85	5.37	5.37	5.891	98.8	100.0	98.5	98.5	99.4
1967	5.62	5.85	5.45	5.45	5.925	100.0	100.0	100.0	100.0	100.0
1968	5.89	5.99	5.335	5.543	6.208	104.8	102.4	97.9	101.7	104.8
1969	6.27	6.37	6.52	6.37	6.575	111.6	108.9	119.6	116.9	111.0
1970	6.73	6.84	7.07	7.25	6.991	119.8	116.9	129.7	133.0	118.0
1971	NA	7.67	7.53	7.73	NA	--	131.1	138.2	141.8	--
1972	NA	8.10	8.17	8.37	NA	--	138.5	149.9	153.6	--
1973	8.50	8.50	8.206	8.40	8.375	151.2	145.3	150.6	154.1	141.3
1974	10.34	10.23	9.875	9.94	9.12	184.0	174.9	181.2	182.4	153.9
1975	12.29	11.99	11.17	11.17	10.75	218.7	204.9	205.0	205.0	181.4
1976	13.15	13.05	12.15	12.14	12.84	234.0	223.1	222.9	222.7	216.7
1977	14.60	13.88	13.70	13.71	15.62	259.8	237.3	251.4	251.6	263.6
1978	16.24	15.88	14.79	15.12	17.33	289.0	271.5	271.4	277.4	292.5
PERCENT CHANGE:										
1965-1978	192.6	178.6	179.1	185.3	192.5					

Source: Iron Age

TABLE FIFTEEN
PRICES OF METALS COMMONLY USED IN THE SHIPBUILDING INDUSTRY
1965-1978

Year	(¢ per lb.) Finished Steel	Aluminum	Electrolytic Copper	Indexed (1967=100) Finished Steel	Aluminum	Electrolytic Copper
1965	6.368	24.51	35.36	98.5	98.1	93.2
1966	6.399	24.50	36.00	99.0	98.1	94.9
1967	6.464	24.98	37.95	100.0	100.0	100.0
1968	6.60	25.00	40.88	102.1	100.1	107.0
1969	7.091	27.18	47.51	110.0	108.8	125.2
1970	7.650	28.70	58.39	118.3	114.9	153.9
1971	8.429	29.00	52.09	130.4	116.1	137.3
1972	8.999	26.50	51.24	139.2	106.1	135.0
1973	9.380	25.17	59.86	145.1	100.8	157.7
1974	11.141	34.06	77.09	172.4	136.4	203.1
1975	13.102	39.83	63.44	202.7	159.4	167.2
1976	14.213	44.65	68.95	219.9	178.7	181.7
1977	15.579	51.25	66.17	241.0	205.2	174.4
1978	17.957	54.50	65.64	277.8	218.2	173.0
PERCENT CHANGE: 1965-1978	182	122	86			

Source: Iron Age

This data turns out to be reasonably consistent with that shown in Table Fourteen. The price of steel plate, for example, increased by 21.3% from 1965 to 1970. However, the increase from 1965 to 1978 was rather astounding 193% with the greater bulk of the change coming after 1973. Equally moderate price increases were recorded for structural shapes, hot rolled strip, hot rolled sheets, and merchant bars between 1965 to 1970. Indeed, price increases were relatively moderate until 1973 when they accelerated sharply to the point that price increases for individual shipbuilding metals of 14-20% per year are no longer uncommon. Indeed, the prices of most of the items listed in Table Fourteen virtually doubled from 1973 through 1979 and would appear to be ready to double again between 1978 and 1983. To the extent that Table Fourteen is representative of the type of materials used in the shipbuilding industry, these data support our earlier contention that there is no major dicontinuity in the trends in the cost of shipbuilding material when the FFG7 class is compared to either the FFG1 or 1052 class vessels. Annual rates of increases of from 14 to 20% annually mean that prices will double every three to five years. As must be obvious, none of these costs can be controlled either by the Navy or the shipbuilding industry.

Table Fourteen provides additional insight into the data displayed in Table Thirteen and provides additional confirmation on our contention of verifiable changes in the cost of raw materials. Here it should be noted that the prices of materials used in shipbuilding, and other forms of heavy construction, have accelerated at rates far in excess of the market basket of goods classified in either the Consumer Price Index or the Wholesale Price Index and that reference to these indices are inappropriate for the task at hand. The reasons for the unusual rate of growth in the prices of raw material are, of course, beyond the scope of this report and have to do with such factors as the increased need for the U.S. to import high grade iron ores, the increased cost of processing lower grade ores otherwise available domestically, and economic trends within the so-called Third World. Irrespective of the reasons for these increased prices, however, they are a fact of the market place to which the Navy has no choice but to <u>accommodate</u>.

B. RAW MATERIAL UTILIZATION: U.S. SHIPBUILDING INDUSTRY

In order to verify the applicability of the data contained in Tables Fourteen and Fifteen to the shipbuilding industry, we also developed data on the utilization of raw material per shipyard production worker for the 15 year period beginning in 1961 and ending in 1976. This data, as with earlier data on the industry, is based on an analysis of Exhibit I and is presented in Table Sixteen. It confirms the cost trends established by the basic data set out in Tables Fourteen and Fifteen and shows the increased monetary value of raw material consumed by the shipyard production line worker. Once again, in order to make certain that trends within the shipbuilding industry were consistent with those found in other industries, we gathered similar data for four other industries. As the data show, the trend in the shipbuilding industry is not unlike that found in other key industries in the United States.

Indeed, the monetary value of the raw material consumed per shipyard worker increased at a lower rate than that which obtained in the other industries tracked in this project.

As is obvious, these figures are uncorrected for any imputed increase in worker productivity and, as such, reflect solely the inflationary factors alluded to in Tables Fourteen and Fifteen. The sheer, unadorned fact is that our economy has been subject to significant inflationary pressures ever since 1945, with gradual increases in inflation rates through the 1960s. These rates then reached explosive proportions in 1972 and 1973 such that direct comparisons between the prices, products and/or services after 1973 are subject to significant adjustments.

In a sense, this has been the key message of this entire report -- that inflation in wage scales, in related supplementary salary costs, in the costs of supplies, equipment, and raw materials used in the construction of a ship have increased more rapidly since the early 1960s than is otherwise contem-

TABLE SIXTEEN
RAW MATERIAL UTILIZATION PER PRODUCTION WORKER
SELECTED INDUSTRIES
1961-1976

Year	Shipbuilding SIC 3731	Aircraft SIC 3721	Iron & Steel Forgings SIC 3462	Int. Combust. Engines SIC 3519	Pumps & Pumping Eqpt. SIC 3651
1961	$7,302	$17,067	$13,387	$16,529	$15,378
1962	7,617	15,789	14,667	17,629	15,842
1963	6,907	16,610	16,241	17,761	16,923
1964	7,918	19,512	17,733	19,761	17,325
1965	7,908	19,883	18,916	19,755	18,702
1966	8,632	16,392	20,818	21,687	19,745
1967	9,544	24,385	19,909	22,750	20,640
1968	9,678	25,264	21,125	24,240	21,313
1969	9,390	25,820	22,455	27,074	22,400
1970	10,142	30,759	21,517	26,450	22,941
1971	11,295	37,007	22,707	28,326	25,413
1972	11,864	30,710	27,704	33,596	25,510
1973	14,405	34,058	29,645	37,286	37,692
1974	17,550	37,259	35,781	46,721	46,805
1975	20,241	47,066	38,867	52,107	53,750
1976	19,773	54,973	40,967	61,200	62,385
PERCENT CHANGE:					
1961-1976	170	222	206	270	306

plated. Further, the impact of inflation has not been felt equally by all segments of our economy; some costs have risen at a faster pace than others. Of these the rapid rise in the cost of housing is perhaps the most significant to this project since residential housing is the largest construction-oriented industry in the United States and, along with industrial construction, a major competitor for the labor skills used in a shipyard and, to a lesser extent, the raw materials. The increased costs of naval construction then have been somewhat a mirror image of increased costs in our civilian economy.

VI. CONCLUSION

Based on our analysis, we do not believe that there are any major discontinuities in the shipyard costs of the FFG1, 1052, and FFG7 programs when these programs are compared to each other. At the shipyard level, the major factor driving costs upwards has been the general inflationary trend within our economy.

Labor costs at Bath Iron Works appear to be more consistent with general economic trends than those at Todd/Seattle. However, Bath is the prime if not the sole major employer of persons in the Bath, Maine area and Todd/Seattle competes not only with other busy shipbuilding and repair yards but also with the aerospace and construction industry for personnel. Given their locations, then, these differences are explainable.

Overhead costs and rates at the two yards are similarly divergent but since a heavy portion of overhead is related to supplemental labor costs, these differences must be expected. Of note here is the fact that the overhead account must also absorb the salary costs and benefits of indirect labor personnel, some 600 people at Bath, and 550 people at Todd. Thus, overhead costs and rates, as we have defined them, are very much a function of underlying wage and salary scales and account for between 60-70% of the total overhead costs incurred by both yards. On the assumption that labor costs are reasonably well controlled by the shipyard, the amount of costs otherwise controllable by management in the Direct Labor and Overhead Cost category are small when measured against the total cost incurred.

Material costs at both yards are reasonably similar as would be anticipated by a review of the planning process that preceded the implementation of the FFG7 program. Once again, material costs appear to be consistent with known trends within our economy. We see no major divergence here if appropriate indicators are used.

As noted in the report, the one cost category that we are not able to reconcile to our complete satisfaction is overhead. Here costs appear to be $3-5,000,000 higher than might otherwise be anticipated. Although we cannot prove it, it appears evident from our analysis that these costs reflect the costs of federally mandated programs such as OSHA, the cost of compliance with an increased number of federal and state programs, and the inevitable result of new DoD regulations and DARs calling for more "control" functions to be performed at the contractor level. Because industry does not maintain its records in a manner consistent with a detailed analysis of these cost drivers, it is now impossible to fully assess their cost. The existence of the discrepency noted above, however, does not point in this direction.

In summation, then, the current shipyard cost of the FFG7 program is due primarily to factors above and beyond the control of either the Navy or the shipbuilding industry. For the most part, these high costs are due to the inflationary trend within our economy, a trend which has rapidly accelerated since 1973 and now appears to be the main cost driver not only for the U.S. shipbuilding industry but for our industrial economy in its entirety.